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APPLICATION FOR UNITED STATES LETTERS PATENT

FOR

MOLDED WALL PANEL AND HOUSE CONSTRUCTION

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[0001] This application is a continuation of U.S. Application No. 10/106,152, filed March 26, 2002, which is a continuation of U.S. Application No. 09/293,223, filed April 16, 1999, which is a continuation-in-part application claiming priority to Application Serial No. 08/787,456, filed January 22, 1997, now abandoned. The entirety of each of the priority documents is hereby incorporated by reference.

BACKGROUND AND SUMMARY OF THE INVENTION

[0002] The present invention relates to a modular house construction, and, more particularly, to a molded wall panel for pre-assembled house construction.

[0003] Buying a home is one of the most significant investments a consumer can make. Home buyers want to live in a modern home with all the presently available conveniences. Unfortunately, buying a home similar to the one they grew up in, with all the "gingerbread" and detail, has become cost-prohibitive and many home buyers have to settle for homes with which they are not happy.

[0004] Past attempts have been made at decreasing the cost of home construction by prefabricating certain portions of the home off-site. However, known modular house units have failed to provide an equivalent finished home as compared to homes which are built completely on-site. Known prefabricated home units, which may have resulted in initial cost savings, are relatively simple units which do not portray any unique architectural features with respect to other units. Additionally, these known

modular units are not constructed with the equivalent structural integrity and quality as traditionally built homes.

[0005] Accordingly, there is a need for prefabricated wall and roof units and house components which:

are modular;

may be wholly constructed off-site;

may have a resilient exterior which replicates the look of virtually any building material and allows for design flexibility;

have injected insulation;

reduce maintenance requirements;

allow for construction in a quality controlled environment;

allow for wiring harnesses and plumbing designed into the structure; and

reduces the cost and time for quality home construction.

[0006] The home constructed from the modular house component of the present invention is preferably based on a framework of welded steel and a sheet steel floor deck. In the preferred embodiment, a ceramic, or a resin porcelain laminated, exterior panel is attached to a steel frame. The exterior, or external, panel may be molded to replicate the look of any building material available. The interior walls are preferably dry-walled and painted. Structural insulating foam is preferably injected between the exterior and interior panels. The home constructed from the walls of the present invention may be placed on any type of traditional building foundation.

[0007] The wiring harness, plumbing, and HVAC may be designed into the structure. The interior finishes are preferably typical of present housing fixtures: wood trim, cabinets, counter tops, appliances, plumbing fixtures, lighting fixtures, and floor coverings. The roof may also be made of welded structural steel and finished with a resin porcelain laminated exterior panel, molded to replicate the appropriate look of any roofing materials desired. The exterior panel of the present invention is a resilient exterior house wall which:

can be molded to replicate popular building materials and architectural features;

is resistant to fire;

maintains interior environmental temperatures better than traditional homes;

is resistant to termites and other rodents;

can be glued to a steel house frame; and

which can be prefabricated in an off-site, quality controlled, environment; and

can be repeatedly molded from one manufactured mold.

[0008] The exterior, or external, panels are molded and attached, preferably, to steel frames off-site. The steel frames have openings for the insertion of windows and doors, or any other building fixture. The steel frames are preferably welded, off-site, to a framework of upright beams and floor panels. Interior, dry-walled, panels are preferably attached to the steel frames. Foam insulation is preferably injected into the space between the exterior and interior panels. These components, once assembled, define a prefabricated modular house component which may be assembled off-site in a quality controlled environment. Decorative details such as carpet, light fixtures,

decorative borders and wallpaper, cabinets, and electrical outlets may all be installed at the factory. Once completed, the modular house component may be transported to the building site, via truck, where the house component may be easily assembled to the foundation and other modular house components and roof units. Once the foundation has been built, and the modular house component built off-site, the actual house can be assembled on-site within a matter of a few days.

[0009] The prefabricated wall and roof units, and accordingly the modular house components, of the present invention may be constructed in an efficient, quality controlled, environment remote from the building site. The modular house components and roof units may then be transported to the building site for efficient installation. The method of the present invention allows for the construction of homes with unique external architectural features while saving costs and without sacrificing quality.

[0010] In addition to the features mentioned above, objects and advantages of the present invention will be readily apparent upon a reading of the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Novel features and advantages of the present invention, in addition to those mentioned above, will become apparent to those skilled in the art from a reading of the following detailed description in conjunction with the accompanying drawings wherein similar reference characters refer to similar parts and in which:

Figure 1 illustrates a front elevational view of a house of the present invention;

Figure 2 illustrates a frame of the present invention;

Figure 3 illustrates a flowchart for producing wall units of the present invention;

Figure 4 illustrates a cross-sectional view of the layers of a preferred embodiment of a wall unit of the present invention;

Figure 5 illustrates a roof frame of the present invention;

Figure 6 illustrates an elevational view of assembled roof units of the present invention;

Figure 7 illustrates the frame of a modular house component of the present invention;

Figure 8 illustrates a modular house component of the present invention depicting one electrical wiring embodiment;

Figure 9 illustrates an assembled house frame of the present invention;

Figure 10 illustrates a preferred embodiment of a foundation;

Figure 11 illustrates the preferred assembly means for adjacent house components of the present invention;

Figure 12 illustrates the stacking of modular house components of the present invention;

Figure 13 illustrates a preferred assembly means for a house of the present invention;

Figure 14 illustrates another view of the preferred assembly means of the present invention;

Figure 15 illustrates another embodiment of an assembly means for the present invention;

Figure 16 illustrates one embodiment of the roof assembly means of the present invention;

Figure 17 illustrates an elevational view of a exterior panel of the present invention;

Figure 18 illustrates a plan view of a connection-line covering panel of the present invention;

Figure 19 illustrates a house of the present invention;

Figure 20 illustrates how a modular house component may be transported to the building site; and

Figure 21 illustrates how a modular house component may be installed.

DETAIL DESCRIPTION OF PREFERRED EMBODIMENT(S)

[0012] The preferred system herein described is not intended to be exhaustive or to limit the invention to the precise forms disclosed. They are chosen and described to explain the principles of the invention, and the application of the method to practical uses, so that others skilled in the art may practice the invention.

[0013] **Figure 1** illustrates one embodiment of a house **2** constructed from a prefabricated wall unit **10** of the present invention. The prefabricated wall unit **10** is comprised of a frame **12**, and an exterior panel **14** attached to the frame **12**. In the preferred embodiment, the exterior panel **14** is comprised of a molded material which replicates known building features and materials. For example, a mold or plug, of a wood panel wall with antique features may be used to produce wood panel replicates.

In another embodiment, a mold depicting a predetermined texture of a roofing material may be used to form external panels **34** of the roofing units **18** of the present invention. Additionally, ornamental architectural features may also be formed integral with the panels **12**, **34**.

[0014] It is preferred that the wall units **10** of the present invention be further comprised of an insulation layer **16** adjacent to the exterior panel **14**. In the preferred embodiment, the insulation layer **16** is non-water-based foam material which has been injected into the wall unit **10**.

[0015] It is preferred that the exterior panel **14** be attached to the frame **12** using an adhesive glue. In the preferred embodiment, the adhesive is a commercially available product called Pliogrip, although there are equivalent products on the market. This adhesive can effectively bond the exterior panel **14** with the steel frame **12**. In the preferred embodiment, the external panel **14** is a resin porcelain laminated exterior (for example, a Modar resin or modified acrylic resin). In alternative embodiments, the exterior panel may be made from polymer ceramic composites or fiberglass strands. Exterior panels **14** may be molded from resins and finished with the look of any traditional exterior building materials. The colorization is preferably incorporated into the materials themselves. These exterior panels **14** created with these inert materials are resilient as well as being very resistant to fire. These materials also have excellent environmental advantages over traditional homes as they act to keep the interior air temperature within the home stable with respect to the outside temperature.

Additionally, while replicating the look of any building material, such as wood, the molded exterior panel **14** is resistant to termites and other rodents.

[0016] Using molded external panels **14** allows the builder to construct the wall and roof units in an off-site factory which utilizes a quality controlled process for increasing the quality of construction of the units. The carpenter preparing the positive for the mold of the exterior panel **14** need only be concerned about quality the first time he makes the positive. Subsequently, external panels **14** formed from the mold have the same quality as the positive which was used to form the mold. This has significant advantages over traditional home making done on-site as the exterior panels **14** of the present invention are made with the similar high quality, from the first panel to the last panel produced, whereas the quality of the on-site house construction depends on the skill of the particular carpenter on a particular given day. Once assembled the wall and roof units may be transported to the building site for easy and cost-efficient installation.

[0017] **Figure 2** illustrates a frame **12** of the present invention. The frame **12** of the present invention is preferably made from a steel tubing (however the frame **12** and framework of the present invention can alternatively be made of wood, stone, or other equivalent building material). The exterior panel **14** is adhesively attached, or bonded, to the frame **12** using an adhesive glue. Steel anchors may also be used to anchor the exterior panel **14** to the frame **12**. These anchors may be spot-welded to the frame **12** for further support. The steel frame **12** of the present invention contains openings **24** of predetermined size, depending on the size of the windows **26** or doors **28** to be placed in that particular opening **24**. These openings **24** can be configured to received any

size window **26** or door **28**. Unlike traditionally built homes, the windows **26** and doors **28** of the present invention may be directly attached, or hinged, to the frame **12** with an adhesive glue. Traditional homes, built on-site, require additional door or window borders to be built onto the frame requiring additional work and costs. The prefabricated steel frame **12** with predetermined size openings **24** for the fixtures again allows for consistent structural quality and dimensions of each wall unit **10** so the windows **26** and doors **28**, which may be standard high quality windows, will fit exactly into the respective openings **24** of the prefabricated steel frames **12**. Traditionally built homes do not have these guarantees, even despite higher construction costs, as each frame and each additional window and door border must be built on-site, where there is no stringent quality controlled processes to ensure structural consistency and quality.

[0018] **Figure 3** illustrates the process for fabricating the wall units **10** of the present invention. Generally, the fabrication of the wall units **10** of the present invention is accomplished through layering of laminate material which creates an interlinking between each layer, both chemically and mechanically. The properties which come out of this layering arrangement allows for a better R factor and greater hardness and molding characteristics which allows the finished product to look more like the real materials.

[0019] The process for producing the prefabricated wall units **10** and roof units **18** is preferably accomplished by: preparing a plug or mold (discussed in more detail below) of a predetermined building feature; filling the mold with a predetermined material (as discussed above) for preparing a molded exterior panel **14** (the mold may

be covered with a layer of wax before filling it to allow easy separation of the hardened molded exterior panel **14** from the mold); removing the molded exterior panel **14** from the mold; and then adhesively attaching, or bonding, the molded exterior panel **14** onto a frame support **12**.

[0020] The mold is prepared by first constructing a positive of the panel piece. For example, if the constructed house of the present invention is to have brick walls, a positive of a brick wall is first constructed (the size and texture of the bricks used can be varied depending on the tastes of the builder or home buyer). A silicon based mold material is then poured over the positive which is then allowed to cool. Once hardened, the positive is removed from the mold material leaving a mold cavity. Subsequently, any of the materials, or equivalents thereof, discussed above for forming the external panels **14** or roof units **18**, may be poured into the mold. Once hardened, the mold is removed from the inserted material leaving a finished external panel piece **14** or roof panel **34**.

[0021] Specifically, the fabrication process of the present invention is based on a patterned application of predetermined material layers applied to the mold. The pattern preferably follows a grid like pattern with emphasis on high impact areas. These grids increase directional impact characteristics allowing the panel to become a structurally integrated component. These layers integrate to form the molded laminate wall of the present invention.

[0022] The first layering step is comprised of the gel coating and surface coloring layer. The gel coat mixture is preferably comprised of three parts: the gel coat, KZ

Ceramic and catalysts. Application of the gel coat, which is a commercially available product, is preferably sprayed onto the surface of the mold surface. This allows the color of the panel to be impregnated into the surfaces of the finished product. As an example, the total mixture of the gel coat is based on 100% as a starting point. 10% by weight of number 9# KZ Ceramic (from Ceramic Technologies) is mixed into the gel coat. At that point in time, as production starts, 1.5% of the catalysts is mixed into the mixture to oxygenate the resin that makes the mixture harden. This hardening process may take around 45 minutes.

[0023] Upon hardening of the gel coat, a first coat of ceramic resin is sprayed uniformly into the mold on top of the hardened gel coat. The second coat is grid sprayed to increase structural characteristics. The material may be sprayed in a grid like pattern (e.g., intersecting lines forming 2 inch squares) by using a modified chopper gun. As one example, the mixture may be 1500 tooling resin at 50% of the total mix, 50% number 6# KZ Ceramic (from Ceramic Technologies), and 3% glass beads, and 1.5% catalysts. The curing process may take 4 to 8 hours to reach full cure. In a preferred process, this layer is then pressed for improving density characteristics of the panel. The ceramic coatings allow for an interlacing between materials which increases the R rating and hardness of the panel.

[0024] After the ceramic resin coating has been applied, resin and fiber glass strains may be layered on top. It is preferred that a uniform layer be applied in the first pass of this process. A second pass of the resin and fiber glass mixture is applied in a grid like manner which again improves the structural strength of the panel. In a

preferred embodiment, this layer is applied while the ceramic resin coating layer is curing. Upon placing all the layers into the mold, a male contour "lid" portion of the mold is preferably placed on top of the layers. A vacuum is then applied, preferably to the lid portion, which squeezes the air out of the mold while forcing the "lid" portion to the mold. This air release results in a dense molded material. The mixture of this layer, as an example, may be comprised of: 50% of 814 modar resin, dehydrated alumina (e.g., 11 lbs white and 11 lbs brown). The resin may be promoted with .2% of Dimethyl aniline and .3% of cobalt naphthenate #6, and 1.5% catalyst.

[0025] Molds can be created which may replicate any building material. Molds of brick walls, wood walls, stone walls, stucco walls, and any other material can be replicated with the molding process used with the present invention. The external panels **14** created by these molds can be designed to have the look and feel of the building material being replicated. Architectural features such as columns, borders, and even stone statues may be incorporated into the mold so as to produce decorative external panels **14**. These molds can be reused to produce panels **14** over and over having the same consistent quality from the first panel to the last produced. As long as the mold is made properly, every exterior panel **14** formed will have the highest quality and consistency. The panels **14** will fit snugly over the steel frames **12** without undesired variations. Accordingly, centuries old Victorian houses can be economically replicated and reproduced using the mold forming process of the present invention. Decorative borders need only be made once, or even stripped from old houses, to be

used as a mold positive for forming exterior panels **14**. The versatility of the new home construction process of the present invention is virtually limitless.

[0026] **Figure 4** illustrates a cross-sectional view of the layers of the wall unit **10** of the present invention. An interior panel **30** comprised of a dry-wall construction is bonded to the interior side **20** of the steel frame **12**, or on the side opposite the exterior panel **14**. The interior panel **30** may be attached to the steel frame **12** at the factory or on-site. The interior panel **30** has all the electrical wiring, phone wiring, fixture and cable outlets built into it. The wiring of the house, established through the chassis of the steel frame **12,** corresponds to the outlets contained in the interior wall panel **30**. A layer of insulation material may be secured to the inner side **20** of the external panel **14**. It is preferred that an insulation foam be injected between the exterior and interior walls panels after they have been bonded to the steel frame **12**. The plumbing fixtures and pipes are additionally secured, prefabricated, into the wall unit **10** at the factory site. In another embodiment, certain plumbing fixtures, such as the tub, sink, and toilet, may be molded integrally as part of one of the wall units **10**.

[0027] The panel **14** is preferably glued to the steel frame **12**. Subsequently, this structure is then placed in a press and compressed while injecting insulating foam into the structure. Injecting the foam under pressure prevents the panel **14** from coming off the frame **12** thus increasing the density of the foam insulation layer and improving the structural characteristics of the wall unit.

[0028] **Figure 5** illustrates a frame **32** of a roof unit **18** of the present invention. A prefabricated roof unit **18** may be constructed with the same process as the

prefabricated wall unit **10** discussed above. The main difference with the roofs, as opposed to the walls, being the shape of the frame and the roofing molds used for producing the roof units **18** will be different from those used with the wall units **10**. Accordingly, the roof unit **18** of the present invention will, preferably, be comprised of: a frame **32** and an exterior panel **34** attached to the frame **32**. Similar to the wall units **10**, the roof units **18** have exterior panels **34** which are molded to replicate predetermined building materials or roof textiles. These roof units **18** may also be fabricated in an off-site factory, and may be transported to a building site for easy and cost-efficient installation.

[0029] It is preferred that the roof unit **18** have a frame comprised of steel. The roof unit **18** has bolt openings **38** for securing each side of the roof (or roof units **18**) together. **Figure 6** illustrates an elevational view of the pinnacle of the roof unit **18**. As depicted, the steel frames **32** of the roof units **18** are bolted together **42** at the top of the roof. A ridge cap **40** is inserted into the top of the roof unit **18** so as to plug the gap between the attached steel frames **32**.

[0030] As discussed above, the wall units **10** and the roof units **18** of the present invention are assembled off-site in quality controlled factory environments. The wall units **10** may also be assembled into more complete modular house components **44** at the off-site factory (on-site meaning the actual home building site).

[0031] The modular house component **44** of the present invention is preferably comprised of: a floor panel **46**; lateral beams **17**; at least two upright beams **48**, preferably four, attached to the corners of the floor panel **46**; at least one frame **12**

(one for each external wall) adhesively attached to the upright beams **48**, the frame **12** having a predetermined number of openings **24** for the placement of fixtures such as windows and doors; and an exterior panel **14** adhesively attached to the frame **12**, where the exterior panel **14** is molded to replicate a predetermined building material. (Again the frame **12** and exterior panel **14** make up the wall unit **10** of the present invention.) It is preferred that the house component **44** have floor supports **13** (or ceiling supports **15** if it is a top floor component **44**). The house components **44** may be attached to each other side-by-side or stacked immediately on top of one another to make a completed house assembly (the assembly discussed in more detail below).

[0032] **Figure 7** illustrates a stage of construction of a modular house component **44**. In **Figure 7** a frame **12** has been attached to the structure formed from the lateral beams **17** and at least two upright beams **48.** The exterior panel **14** has not yet been secured to the frame **12** in the modular house component of **Figure 7** (see also **Figures 20 and 21** illustrating the installment of a modular house component **44**).

[0033] In the preferred embodiment, the floor panel **46**, the lateral beams **17**, the frame **12**, and the upright beams **48** are comprised of steel. Accordingly, these parts are preferably welded together.

[0034] **Figure 8** illustrates a perspective view of one modular house component **44** depicting an example wiring embodiment, shown generally at **50**. Again, the wiring of the house component **44** can be done at the off-site factory. Accordingly, the house component **44** can be transported to the building site completely assembled and ready to be connected to the foundation **52** and other modular house components **44**.

[0035] Again, in the preferred embodiment, the wall unit **10** of the modular house component **44** has an interior dry-walled panel **30** securably attached to the frame **12**. The modular house component **44** may be completely furbished and decorated at the off-site factory. For example, carpet or hardwood floors may be laid over the floor panel **46**. Decorative borders, wallpaper, and fixtures may be applied to the interior walls **30**. In other words, the house component **44** can be completely manufactured and decorated off-site (similar to a quality controlled automobile factory).

[0036] A predetermined number of modular house components **44** may be assembled on-site to an already constructed foundation **52** to form a completely assembled house **2**. The number of house components **44**, the size, and decorative details of each house component **44** will vary on the style of the house **2** and the specific design preferences of the homeowner. However, in the preferred embodiment the house of the present invention comprises: a foundation **52**; at least one prefabricated modular house component **44** securably attached to the foundation **52**, the prefabricated modular house component **44** having at least one wall unit **10** having a molded external panel **14** comprised of a predetermined ceramic material; and a prefabricated roof unit **18** for attachment to the prefabricated modular house component **44**. The details of the assembly of these separate components will be discussed below.

[0037] **Figure 9** illustrates a frame structure of a modular house of the present invention. The external panels have not been depicted in the following figures so as to better illustrate the assembly means of the present invention (or in other words, how the

separate house components **44** are attached to each other, the foundation **52**, and the roof units **18**).

[0038] Once the modular house components **44** have been delivered to the building site, the first floor modules **44** may be attached to the constructed foundation **52**. Industrial cranes are used to hoist the house components **44** into position. **Figure 10** illustrates the preferred foundation **52** and the means to attach the house components **44**. As depicted in **Figure 10**, it is preferred that the foundation be a pylon-drilled foundation. (A stone skirt **54** can be attached around the foundation once the house **2** has been assembled). The house components **44** may be adjustably bolted to the foundation **52** as depicted in **Figure 10**.

[0039] Once the modular components **44** have been attached to the foundation **52** they are preferably secured together. **Figure 11** illustrates the preferred means for securing adjacent house components **44**. The bolt **56** in **Figure 11** securably attaches the house components **44** with respect to each other.

[0040] Two separate modular house components **44** can be stacked immediately on top of each other. **Figure 12** illustrates how modular house components are stacked together.

[0041] Modular house components **44** which have been stacked together are preferably bolted to each other. **Figure 13** illustrates a close-up view of a cross-section of a house assembly of the present invention depicting the bolting means **58**. The lateral beams **17** of stacked modular components **44** are preferably bolted together by the bolts **62**. **Figure 13** illustrates a wrench **60** inserted through a hole **64** in the lateral

beam **17** used to tighten the bolt **62**. The upright beams **48** of adjacent modular house components **44** are preferably secured by bolts **56**, **66**. **Figure 14** illustrates another view of the assembly means of the house **2** of the present invention.

[0042] The roof unit **18** of the present invention is also securably attached to the house components **44** by a bolt construction. The frame **32** of the roof unit **18** is bolted to the lateral beam **17** of the top-most modular house components **44** by bolts **68** (see **Figure 15**). It is also preferred that the roof frame **32** have mounts **70** for accepting bolts **72** from the corner uprights **48**. **Figure 16** also illustrates a drainage gutter **74** which has been molded as part of the exterior panel **34**. This one piece construction is beneficial as drainage gutters have been known to easily become damaged and easily detached from the house structure. The preferred steel frame assembly as described above results in a sturdy house which can withstand much greater loads than traditionally built homes.

[0043] **Figures 17 and 18** illustrate a means for hiding the connection lines **76** between adjacent modular house components **44**. A separate panel piece **78** may be form-fitted over the connection line **76**. **Figure 19** illustrates one embodiment of a completed house **2** constructed from modular house units **44** of the present invention. Houses **2** such as the one depicted in **Figure 19** may be assembled on-site within a few days without sacrificing quality while lowering construction costs.

[0044] Having shown and described a preferred embodiment of the invention, those skilled in the art will realize that many variations and modifications may be made to affect the described invention and still be within the scope of the claimed invention.

Thus, many of the elements indicated above may be altered or replaced by different elements which will provide the same result and fall within the spirit of the claimed invention. It is the intention, therefore, to limit the invention only as indicated by the scope of the claims.